

WHAT IS CLAIMED IS:

1 1. An end-effector device for use with an electrosurgical instrument for
2 robotic surgery, the end-effector device comprising:
3 at least one active electrode at a distal end of the device;
4 coupling means adjacent a proximal end of the device for coupling the device
5 with the electrosurgical instrument; and
6 at least one insulation material disposed at least partially around the active
7 electrode for inhibiting conduction of electrical current from the active electrode to the
8 electrosurgical instrument.

1 2. An end-effector device as in claim 1, wherein the at least one active
2 electrode comprises a scalpel blade, a beaver blade, a hook, a spatula, movable jaws, scissors,
3 a needle point, hockey stick, dissectors, or a probe.

1 3. An end-effector device as in claim 1, wherein the at least one active
2 electrode transmits radiofrequency energy.

1 4. An end-effector device as in claim 1, wherein the coupling means
2 provides for removable coupling of the device with the electrosurgical instrument.

1 5. An end-effector device as in claim 4, wherein the coupling means
2 comprise mechanical attachments.

1 6. An end-effector device as in claim 5, wherein the coupling means
2 comprise threading within an end-effector sleeve for attachment with complimentary
3 threading on a mating component permanently attached to the electrosurgical instrument.

1 7. An end-effector device as in claim 5, wherein the coupling means
2 comprise at least one spring tab or latching member on the proximal end of the device for
3 attachment with at least one protrusion within a housing permanently attached to the
4 electrosurgical instrument.

1 8. An end-effector device as in claim 4, wherein the coupling means
2 comprise electrical attachments.

1 9. An end-effector device as in claim 8, wherein the coupling means
2 comprise an electrical connector on the proximal end of the device for electrical connection
3 with a transmission member via a spring member of the electrosurgical instrument.

1 10. An end-effector device as in claim 8, wherein the coupling means
2 comprise an electrical connector on the proximal end of the device for electrical connection
3 with a transmission member via a gripping member of the electrosurgical instrument.

1 11. An end-effector device as in claim 8, wherein the coupling means
2 comprise an electrical connector on the proximal end of the device and an electrical tab on
3 the proximal end of the electrical connector for electrical connection with a transmission
4 member via an electrical platform of the electrosurgical instrument.

1 12. An end-effector device as in claim 8, further comprising at least one o-
2 ring or silicone potting associated with the coupling means to seal the electrical connection.

1 13. An end-effector device as in claim 4, wherein the end-effector device
2 is disposable.

1 14. An end-effector device as in claim 4, further comprising a lockout
2 feature associated with the coupling means for preventing re-use of the end-effector device

1 15. An end-effector device as in claim 1, wherein the coupling means
2 provides for permanent coupling of the device with the electrosurgical instrument.

1 16. An end-effector device as in claim 1, wherein the at least one
2 insulation material comprises:
3 a first insulation layer disposed at least partially around the active electrode;
4 and
5 a second insulation layer disposed at least partially around the first layer or the
6 active electrode.

1 17. An end-effector device as in claim 16, wherein the first layer
2 comprises ceramic material, glass, silicone, polypropylene, fluoropolymer, or insulating
3 plastic.

1 18. An end-effector device as in claim 17, wherein the second layer
2 comprises ceramic material, glass, silicone, polypropylene, fluoropolymer, or insulating
3 plastic.

1 19. An end-effector device as in claim 17, wherein the first layer
2 comprises a first insulation material completely encircling part of the active electrode, and
3 wherein the second layer comprises a second insulation material completely encircling the
4 first layer and abutting the electrosurgical instrument.

1 20. An electrosurgical instrument for use with a robotic surgical system,
2 the electrosurgical instrument comprising:
3 an elongate shaft having a proximal end and a distal end;
4 an end-effector removably coupled with the distal end of the shaft, the end-
5 effector having at least one active electrode and at least one insulation material disposed at
6 least partially around the active electrode for inhibiting conduction of electrical current from
7 the active electrode to the electrosurgical instrument; and
8 an interface coupleable to the proximal end of the shaft, the interface
9 removably connectable to the robotic surgical system.

1 21. An electrosurgical instrument as in claim 20, wherein the at least one
2 active electrode comprises a scalpel blade, a beaver blade, a hook, a spatula, movable jaws,
3 scissors, a needle point, hockey stick, dissectors, or a probe.

4 22. An electrosurgical instrument as in claim 20, wherein the end-effector
5 further comprises an end-effector sleeve having threading for attachment with complimentary
6 threading on a mating component permanently attached to the distal end of the shaft.

1 23. An electrosurgical instrument as in claim 20, wherein the end-effector
2 further comprises at least one spring tab or latching member for attachment with at least one
3 protrusion within a housing permanently attached to the distal end of the shaft.

1 24. An electrosurgical instrument as in claim 20, wherein the at least one
2 insulation material comprises:
3 a first insulation layer disposed at least partially around the active electrode;
4 and

5 a second insulation layer disposed at least partially around the first layer or the
6 active electrode.

1 25. An electrosurgical instrument as in claim 24, wherein the first layer
2 comprises ceramic material, glass, silicone, polypropylene, fluoropolymer, or insulating
3 plastic.

1 26. An electrosurgical instrument as in claim 25, wherein the second layer
2 comprises ceramic material, glass, silicone, polypropylene, fluoropolymer, or insulating
3 plastic.

1 27. An electrosurgical instrument as in claim 24, wherein the first layer
2 comprises a first insulation material completely encircling part of the active electrode, and
3 wherein the second layer comprises a second insulation material completely encircling the
4 first layer and abutting the electrosurgical instrument.

1 28. A method of making an end-effector device for use with an
2 electrosurgical instrument for robotic surgery, the method comprising:
3 assembling the end-effector device, wherein the device has at least one active
4 electrode;
5 applying a first insulator to at least part of the active electrode to inhibit
6 surface conduction of current from the active electrode back to the electrosurgical instrument;
7 and
8 applying a second insulator to at least part of the active electrode or the first
9 insulator to further inhibit surface conduction from the active electrode back to the
10 electrosurgical instrument.

1 29. A method as in claim 28, wherein applying the first insulator
2 comprises applying a glass insulator around a portion of the active electrode.

1 30. A method as in claim 29, wherein the glass insulator has a pre-molded
2 shape to fit within a corresponding shape on the active electrode.

1 31. A method as in claim 29, wherein applying the glass insulator
2 comprises soldering or fusing the glass insulator to the active electrode.

1 32. A method as in claim 29, wherein applying the second insulator
2 comprises applying a ceramic insulator around a portion of the active electrode immediately
3 proximal to the glass insulator.

1 33. A method as in claim 28, wherein applying the first insulator
2 comprises coating a length of the active electrode with a ceramic insulator.

1 34. A method as in claim 33, wherein applying the second insulator
2 comprises covering at least a portion of the ceramic insulator with a fluoropolymer insulator.

1 35. A method as in claim 34, wherein at least one of the first insulator or
2 the second insulator abuts the electrosurgical instrument.

1 36. A method of performing a robotic surgical procedure, the method
2 comprising:
3 connecting a surgical instrument to a robotic surgical system, the surgical
4 instrument having an elongate shaft at a distal end of which an end-effector is coupled;
5 passing the end-effector of the surgical instrument through an entry port in a
6 patient body;
7 engaging tissue with an active electrode of the end-effector; and
8 delivering electrical energy to the tissue with the active electrode while
9 inhibiting conduction of the electrical energy from the active electrode toward the distal end
10 of the elongate shaft.

1 37. A method as in claim 36, further comprising removably coupling the
2 end-effector with the surgical instrument.

1 38. A method as in claim 37, wherein removably coupling the end-effector
2 does not require a coupling tool.

1 39. A method as in claim 37, further comprising disabling the end-effector
2 after the robotic surgical procedure is performed.

1 40. A method as in claim 36, wherein delivering the electrical energy
2 while inhibiting conduction is achieved via at least one layer of insulation disposed on at least
3 part of the active electrode.

1 41. A method as in claim 40, wherein the at least one layer of insulation
2 comprises two layers of insulation.

1 42. A method as in claim 41, further comprising sealing the layers of
2 insulation with a silicone adhesive.

1 43. A method as in claim 40, further comprising sealing the insulation
2 layer to the active electrode with an over-molding process.

1 44. An electrosurgical instrument for use with a robotic surgical system,
2 the electrosurgical instrument comprising:
3 an elongate shaft having a proximal end and a distal end;
4 an end-effector removably coupled with the distal end of the shaft, the end-
5 effector comprising:
6 at least one active electrode, the active electrode comprising a hook or
7 spatula;
8 an end-effector sleeve disposed at least partially around the active
9 electrode, the sleeve having threading for attachment with complimentary threading on a
10 mating component permanently attached to the distal end of the shaft;
11 an electrical connector within the sleeve for electrical connection with
12 a transmission member via a gripping member of the mating component; and
13 an interface coupleable to the proximal end of the shaft, the interface
14 removably connectable to the robotic surgical system.

1 45. An electrosurgical instrument as in claim 44, wherein the sleeve
2 comprises an insulation material for inhibiting conduction of electrical current from the active
3 electrode to the electrosurgical instrument.

1 46. An electrosurgical instrument for use with a robotic surgical system,
2 the electrosurgical instrument comprising:
3 an elongate shaft having a proximal end and a distal end;
4 an electrocautery end-effector coupled with the distal end of the shaft, the end-
5 effector comprising:
6 an electrocautery hook or spatula;

7 a first insulation layer disposed at least partially around the hook or
8 spatula so as to inhibit conduction of electrical current from the active electrode to the
9 electrosurgical instrument;

10 a second insulation layer disposed at least partially around the first
11 layer or the hook or spatula so as to further inhibit conduction of electrical current from the
12 active electrode to the electrosurgical instrument; and

13 an interface coupleable to the proximal end of the shaft, the interface
14 removably connectable to the robotic surgical system.

1 47. A robotical surgical system comprising:

2 a robotic arm having an instrument holder;

3 an electrocautery instrument detachably mountable on the instrument holder,
4 the electrocautery instrument having a proximal portion for engaging the instrument holder,
5 an elongate shaft extending from the proximal portion to a distal end, an end-effector
6 removably coupled with the distal end of the shaft, the end-effector having at least one active
7 electrode and at least one insulation material disposed at least partially around the active
8 electrode; and

9 an electrosurgical generator to transmit electrosurgical energy to the active
10 electrode.

1 48. An electrocautery end-effector for use with an electrosurgical
2 instrument comprising a shaft, an end-effector removably coupled to a distal end of the shaft,
3 and an interface coupleable to a proximal end of the shaft, the electrosurgical instrument for
4 use with a robotic surgery system, the electrocautery end-effector comprising:

5 an electrocautery hook or spatula;

6 an end-effector sleeve disposed at least partially around the hook or spatula,
7 the sleeve having threading for attachment with complimentary threading on a mating
8 component permanently attached to the distal end of the shaft;

9 an electrical connector within the sleeve for electrical connection with a
10 transmission member via a gripping member of the mating component; and

11 at least one insulation material disposed at least partially around the hook or
12 spatula for inhibiting conduction of electrical current from the active electrode to the
13 electrosurgical instrument.